

**Observations on Insects Associated with a
Nectar-bearing Chilean Tree,
Quillaja saponaria Molina (Rosaceae)**

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Abstract. — Several species of entomophagous insects were observed feeding on floral nectar of a specimen of soapbark tree, *Quillaja saponaria* Molina (Rosaceae), a landscape plant introduced into northern California from Chile. Entomophaga observed in relatively large numbers included a green lacewing (*Chrysoperla carnea* (Stephens)), convergent ladybeetle (*Hippodamia convergens* Guerin-Meneville), and a brown lacewing (*Hemerobius* sp. (prob. *ovalis* Carpenter)), as well as various unidentified parasitic Hymenoptera. Contingency table analyses of weekly vacuum samples indicated that members of each taxon were significantly more abundant during, as opposed to after, flowering. Samples taken at different times of day indicated that the brown lacewing was mainly a nocturnal visitor, whereas the green lacewing was present at similar densities at all hours tested. These findings suggest that the soapbark tree should be included in experimental schemes for enhancing biological control of agricultural pests.

The use of nectar-bearing trees and shrubs in windbreaks and hedgerows has been suggested as a means of enhancing biological control (Solomon, 1980; Altieri and Letourneau, 1983). The present study concerns attendance by various entomophagous insects at the flowers of soapbark tree, *Quillaja saponaria* Molina (Rosaceae), a landscape tree introduced into northern California from Chile. These initial observations serve as a first step in assessing the possible value of this tree in enhancing biological control of agricultural pests.

In its native Chile, the soapbark tree is said to be responsible for the production of abundant and exquisite honey (Muñoz Pizarro, 1973). In Davis, CA, the plant flowered from early June through early July, and it appeared to be andromonoecious, featuring hermaphroditic flowers early in the blossoming period, and exclusively male flowers thereafter. The flowers exuded a shiny, sticky nectar that was fed upon by a diverse assemblage of insects. The vast majority of flower visitors observed were feeding upon nectar rather than pollen. A sampling program was set up to investigate insect attendance at the tree, with special emphasis on potential biological control agents.

MATERIALS AND METHODS

All data were recorded from one specimen of *Q. saponaria*, approximately 12 m in height and 4 m in basal diameter, growing at the Environmental Horticulture Department grounds, University of California, Davis. Specimens were also present

Table 1. Counts for weekly vacuum samples from *Quillaja saponaria*.

Taxon	Quadrant	No. Collected/Subsample/Date				
		In Flower			Out of Flower	
		6/4	6/11	6/18	6/25	7/2
<i>Hippodamia convergens</i>	West	3	14	18	2	2
	South	9	30	33	0	0
	East	13	35	27	0	0
<i>Chrysoperla carnea</i>	West	7	11	7	0	0
	South	6	15	5	1	1
	East	14	13	4	0	1
<i>Hemerobius</i> sp. (prob. <i>ovalis</i>)	West	0	0	0	0	0
	South	1	0	0	0	1
	East	2	2	0	1	0
Parasitic Hymenoptera	West	8	5	5	2	2
	South	7	4	22	11	3
	East	5	19	19	3	9

at the Berkeley and Santa Cruz campuses of University of California, but none of these trees, to my knowledge, flowered appreciably during the year of this study.

In the immediate vicinity of the experimental site were various trees and shrubs suitable for landscaping in Mediterranean climates; within ca. 2 km were fields of hay alfalfa and winter wheat. The agricultural fields were likely sources of ladybeetles and lacewings observed in the present study.

Using the U.C. Vac suction device (Summers et al., 1984), insects were sampled on 4, 11, 18, and 25 June, and 2 July, 1982. The first three dates occurred during flowering, whereas the latter two occurred after blossom fall. Samples were taken during the early afternoon hours, 1300–1530 PDT. The insects were vacuumed from the flowers and foliage during three one-minute intervals, each corresponding to one of the three accessible quadrants of the tree (east, south, and west—the north quadrant was obstructed by an adjoining shrub). During each one-minute episode, the tree was sampled from ground level to a height of about 2 m. Vacuum samples were retained in organdy net bags, placed on ice, taken to the laboratory, and frozen. Samples were later sorted, and the arthropods in the different taxa counted.

In addition to the regular weekly samples mentioned above, supplementary samples were taken on 5 June at 1200, 7 June at 1800, 5 June at 2215, 12 June at 1800, and 12 June at 2300 (PDT). Together with samples from one of the regular weekly visits (11 June), these latter data were used to compare the diel patterns of attendance by a green lacewing, *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae), and a brown lacewing, *Hemerobius* sp. (prob. *ovalis* Carpenter) (Neuroptera: Hemerobiidae).

Visitation by nectarivorous insects was assessed both qualitatively and quantitatively. A species list was compiled based on the vacuum samples and observation or collection of flower visitors by insect net. The regular weekly vacuum data were analyzed using separate chi-square analyses for 1×2 contingency tables constructed for each of the three taxa, *C. carnea*, convergent ladybeetle (*Hippodamia convergens* Guerin-Meneville; Coleoptera: Coccinellidae), and

parasitic Hymenoptera (all species pooled). As *Hemerobius* were seldom encountered in the regular weekly samples, which were all taken during early afternoon hours, that predator was excluded from these analyses. Comparisons were made for numbers obtained during flowering vs. those obtained after blossom fall. Expected values were generated based on the 3 to 2 ratio of sample dates during vs. after flowering, and the assumption that under the null hypothesis the observed numbers of insects should follow the same ratio. A significant deviation in favor of higher attendance during flowering would be taken to indicate that these entomophaga were attracted to flowers, and not to some unrelated feature of the tree.

In order to determine whether the green and brown lacewings exhibited significantly different diel patterns of attendance, the relevant data were subjected to contingency table analyses via the BMPD-4F program (Dixon, 1983). These data were arrayed in a three-dimensional contingency table employing species, date, and time of day (early afternoon, late afternoon, and late evening) as the variables, and all possible loglinear models were reviewed (see Fienberg, 1977). In the event that a time X species interaction term were required to explain the data, the green and brown lacewings could be said to differ significantly in their diel patterns of attendance.

RESULTS

Several species of insects were found foraging for nectar on the soapbark tree. These included convergent ladybeetle and the green and brown lacewings mentioned. Among the parasitic Hymenoptera, unidentified Diapriidae and Chalcidoidea were most frequently observed. The former were subject to vacuum sampling, whereas the latter tended to pass through the mesh of the net bags. Honeybees, *Apis mellifera* L. (Hymenoptera: Apidae), were commonly collected from soapbark tree flowers. I also observed various aphidophagous hover flies (Diptera: Syrphidae) taking nectar; these included *Scaeva pyrastris* (L.), *Eupeodes volucris* Osten Sacken, and *Metasyrphus* sp. Also, two chloropid flies, probably the aphidophagous *Thaumatomyia glabra* (Meig.) and *T. rubida* (Coquillett), were observed at the flowers, as was Argentine ant, *Iridomyrmex humilis* Mayr (Hymenoptera: Formicidae), and European earwig, *Forficula auricularia* L. (Dermaptera: Forficulidae) (earwigs and ants were encountered principally at night). Minute pirate bug, *Orius tristicolor* (White) (Hemiptera: Anthocoridae) was also commonly found. Neither syrphids nor anthocorids were subject to reliable collection by the vacuum method: the former were too quick to fly, while the latter were so small that many escaped through the organdy mesh of the net bags.

The results for weekly afternoon suction samples are presented in Table 1. The mean counts (\pm S.E.) obtained during flowering were 20.22 ± 3.8 , 9.11 ± 1.39 , and 10.44 ± 2.44 for *H. convergens*, *C. carnea*, and parasitic Hymenoptera, respectively ($n = 9$ for each estimate). The corresponding figures obtained after flowering were 0.67 ± 0.42 , 0.50 ± 0.22 , and 5.00 ± 1.61 ($n = 6$ for each estimate). *Hemerobius* were scant in these diurnal samples that they were not included in these assessments. The contingency table analyses (d.f. = 1 for each test) revealed highly significant differences ($p < 0.01$) for all three taxa assessed (*H. convergens*, chi-square = 111.03; *C. carnea*, chi-square = 47.1; and pooled parasitic

Table 2. Diel attendance patterns for *Chrysoperla carnea* and *Hemerobius* sp. (prob. *ovalis*) on flowering soapbark tree.

Species	Total no. per vacuum sample/time/date ^a					
	First week in June			Second week in June		
	EA	LA	LE	EA	LA	LE
<i>Chrysoperla carnea</i>	36	45	20	28	26	44
<i>Hemerobius</i> sp. (prob. <i>ovalis</i>)	6	3	26	2	1	30

^aEA = early afternoon, LA = late afternoon, LE = late evening.

Hymenoptera, chi-square = 12.908). These results indicate significantly higher numbers during flowering for all three taxa.

The data for lacewing attendance, presented in Table 2, indicate a strong nocturnal tendency for the brown lacewing, whereas the green lacewing was abundant on the plant at all hours assessed. Totals of 64, 71, and 64 were observed for green lacewings for early afternoon, late afternoon, and late evening, respectively. The corresponding totals for brown lacewing were 8, 4, and 56. The chi-square statistics of all possible loglinear models were reviewed, and the most parsimonious model acceptable under the conventional criterion of $p > 0.05$ involved all three main effects plus time \times date and time \times species interaction terms (Likelihood-Ratio Chi-Square = 3.84; d.f. = 3; $p = 0.2790$). The need for the time \times species interaction term indicates that the green and brown lacewings exhibited significantly different temporal patterns of attendance on the flowering tree.

The results do not necessarily indicate that the green lacewing adults were nectar-feeding throughout the day. In fact, the green lacewings were most commonly observed feeding at flowers during the evening hours, so most individuals were probably resting in the tree's foliage during the afternoon and early evening hours. Perhaps the brown lacewing merely rested diurnally in a different stratum than did the green, and so was seldom collected except late at night, when feeding. These questions warrant further investigation.

In summary, the flowering soapbark tree investigated here attracted large numbers of nectar-feeding predators, several of which are known to be important in reducing agricultural pests, and which are known to feed on nectar or honeydew (see Hagen, 1962; New, 1975; Sundby, 1967; Neuenschwander and Hagen, 1980). These results are suggestive, but because of the limited scope of this study, they should be viewed with caution. Given its reputation as a "honey plant," the soapbark tree might be of some value in urban apiculture, quite apart from any role it might play in pest management. The nutritional value of the nectar should also be explored. Finally, the tree should be included in experimental trials of windbreak, hedgerow, and urban landscape vegetation to determine whether it can enhance biological control by the predators that feed so avidly at its blossoms.

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